

Use of the Otoscope in the Evaluation of Common Injuries and Illnesses of the Ear

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Abstract: Ear injuries and/or illnesses make up only a small percentage of the total injuries seen by the athletic trainer. However, if these conditions are left undetected or untreated, permanent ear damage could result. Many ear injuries involve structures that can only be viewed through the use of an otoscope. Although more athletic trainers are using the otoscope to evaluate the ear, there is little documentation available in athletic training literature regarding its proper use. This article describes the proper use of the otoscope in evaluating the ear and discusses the common pathological conditions that might confront the athletic trainer. This article will provide a resource that can be used in conjunction with the guidance of your team physician to help you develop the knowledge and skills required for performing an otoscopic examination.

Recognition of injuries or illnesses of the ear is the first step in ensuring the proper management or treatment of these conditions. Often, the athletic trainer will be confronted with injuries or illnesses involving structures within the external or middle ear that can only be examined through the use of an otoscope. For this reason, the athletic trainer should become familiar and comfortable with using the otoscope in ear evaluation.

In 1990, Jones and Harter⁴ surveyed the directors of the National Athletic Trainers' Association-ap-

proved educational programs concerning their attitudes toward the use of the otoscope in injury/illness evaluation and their perceived proficiency with this instrument. The majority of those surveyed rated themselves as nonproficient. However, they indicated strong support for developing and implementing a formal instructional program for student athletic trainers regarding the proper use of the otoscope.

This article will review the anatomical structures of the ear, discuss the signs and symptoms of the common pathological conditions of the ear, and present the basic steps in performing an otoscopic examination. This article cannot teach proficiency with the otoscope, as that requires extended practice and experience. The purpose of this article is to provide a basic foundation for the development of the knowledge and skills required to perform an accurate otoscopic examination.

Anatomical Review

As with any evaluation technique, an accurate otoscopic examination relies on a good working knowledge of the involved anatomy and physiology. The anatomical structures of the ear can be divided into three parts: the external, the middle, and the inner ear (Fig 1).

External Ear

The external ear comprises the auricle, the external auditory canal, and the outermost layer of the tympanic membrane or eardrum (Fig 1).² The auricle, made up of the pinna and lobule,² is an irregularly shaped

structure consisting of fibroelastic cartilage covered by a thin layer of tightly adherent and sensitive skin.¹ The auricle functions to collect, amplify, and funnel sound to the external auditory canal.² The important anatomical structures of the auricle are shown in Fig 2.

The external auditory canal, which runs a course from the auricle to the tympanic membrane, conveys sound to the membrane and protects the membrane and other structures of the middle ear.² Although the shape and direction of the canal varies among individuals, it usually will be somewhat curved. In adolescents and adults, the canal usually will range from 2.5 to 3 cm in length,^{5,8} while its width will narrow near its midportion and widen again as it approaches the tympanic membrane.⁸

The outer portion of the external auditory canal contains the glands responsible for the production of cerumen or ear wax. Cerumen, which is slightly acidic, helps prevent infections in the external ear since bacteria do not grow well in an acidic environment.⁵

The tympanic membrane is a delicate, paper-thin membrane, which is normally pearly gray in color and semi-transparent in appearance.^{2,3,5,8} This membrane is cone-shaped and tilted slightly forward and downward, such that the top portion is leaning toward the canal. The lower four fifths of the membrane is referred to as the pars tensa while its upper one fifth is known as the pars flaccida² (Figs 3 and 4).

Middle Ear

The structures of the middle ear are shown in Fig 1 and consist of the following:

1. the inner layers of the tympanic membrane;
2. the ossicles or middle ear bones;
3. the middle ear space;
4. the mastoid; and
5. the Eustachian tube;

The malleus, incus, and stapes are the tiny middle ear bones referred to as the ossicles and are located in the middle ear space between the tympanic membrane and the cochlea. The middle ear system functions to

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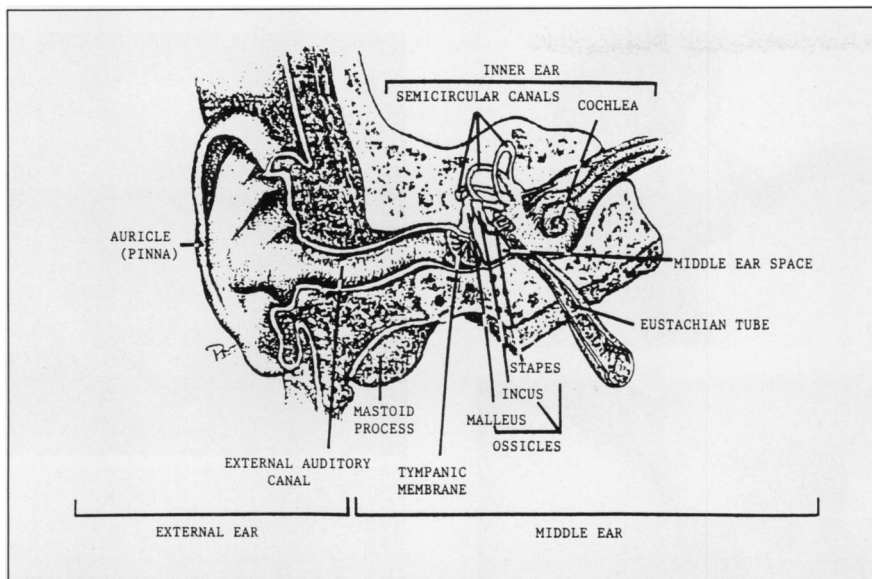


Fig 1.—Frontal section of normal right ear.

amplify and direct sound vibrations to the cochlea located in the inner ear.² For maximal vibration of the membrane, the air pressure behind the membrane must equal that of the atmospheric air outside the membrane. The Eustachian tube, which connects the middle ear space to the nose, maintains this equilibrium of pressure.^{1,2,5} Should this tube become blocked or swollen, normal hearing may be affected.

Inner Ear

The inner ear, which is not visible during an otoscopic examination, consists of the cochlea and the semicircular canals (Fig 1). The cochlea translates sound waves from the ex-

ternal world to the brain, while the semicircular canals provide the body's sense of balance.⁵

Examination

After a thorough history is taken, physical examination begins with observation and palpation of the auricle, including gentle traction on the pinna and slight pressure applied to the tragus and lobule (Figs 5a, b, and c). If this causes discomfort, you should suspect injury or inflammation of the external ear.^{3,8} Next, visually inspect the outer portion of the external auditory canal for redness, swelling, drainage, foreign objects, or any sign of injury such as cuts, bruises, or bleeding.

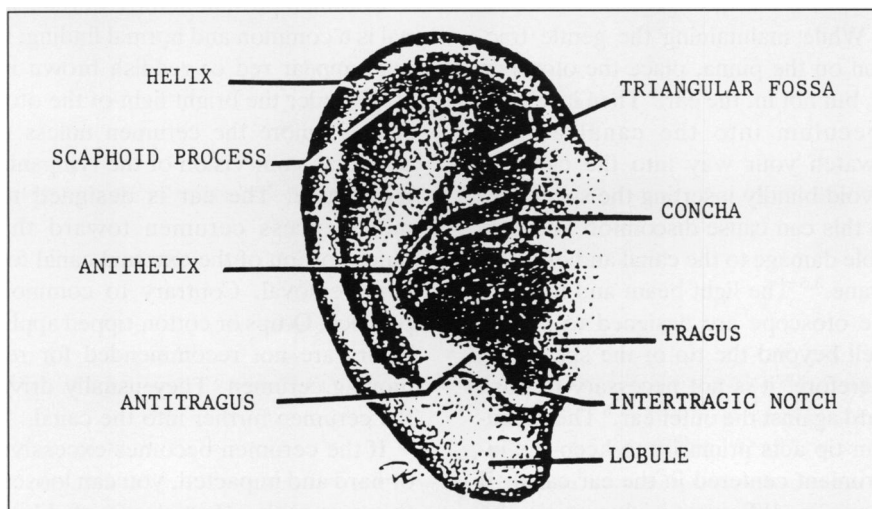


Fig 2.—Anatomical features of the auricle, right ear.

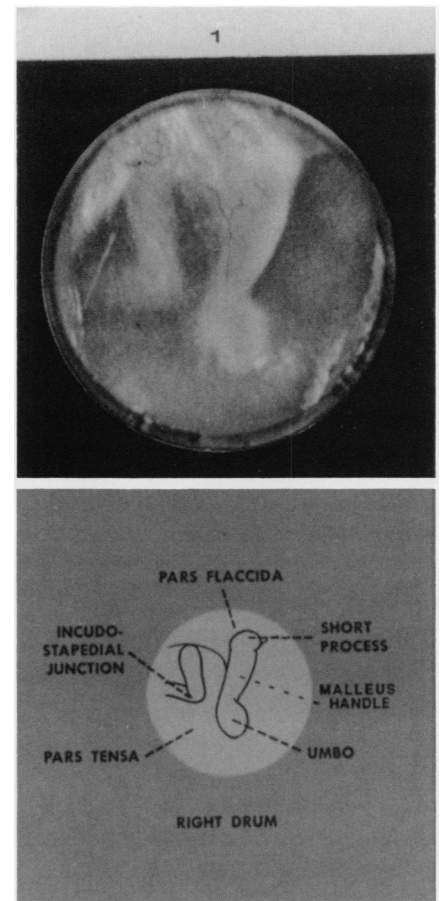


Fig 3.—Normal tympanic membrane, right ear (reproduced from "An Atlas of Some Conditions of the Eye, Ear, and Throat" published by Abbott Laboratories, North Chicago, Ill).

Use the otoscope to inspect the remainder of the canal and tympanic membrane. As with other evaluation methods, examine the asymptomatic ear first. This practice not only provides a basis for comparison but also prevents transferring infectious material from the symptomatic ear to the asymptomatic ear.

Select the largest possible speculum that can be comfortably inserted into the canal.^{2,3,5} When inserted, the speculum should fit snugly into the outer third of the external auditory canal with slight pressure exerted on the tragus and anterior wall of the canal.³ Choosing a speculum that is too small in relation to the ear canal will produce a greater amount of movement within the canal. This increased movement will cause discomfort for the athlete and also reduce your visionary field. The following sizes of specula are most commonly used:

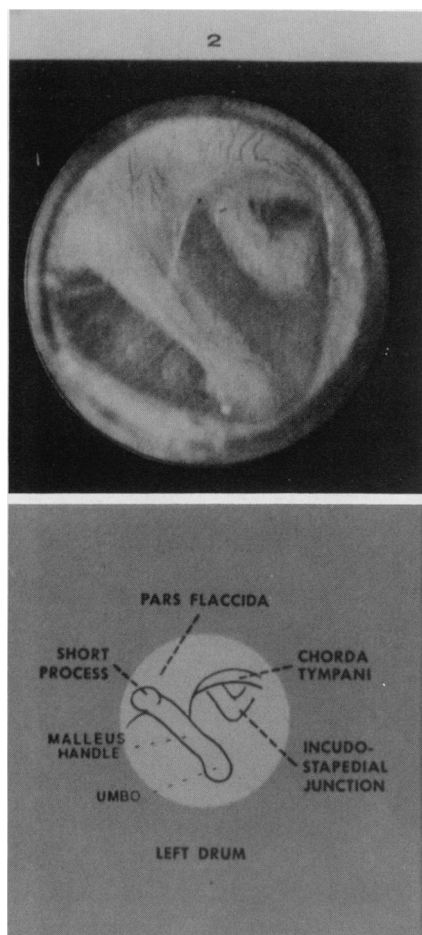


Fig 4.—Normal tympanic membrane, left ear (from Abbott Laboratories; see Fig 3).

adults, 4 to 6 mm; children, 3 to 4 mm; infants, as small as 2 mm.^{2,5}

When performing an otoscopic examination, place your athlete in a seated position with his/her head turned slightly downward and away from the ear to be examined. To provide an optimum view of the membrane, it is often necessary to displace or straighten the canal. Do so by using your free hand to pull the pinna upward, backward, and outward. Grasp the pinna at the 10 o'clock position when examining the right ear and the 2 o'clock position when examining the left ear. Hold the otoscope in the hand closest to the front of the ear (right hand for the right ear, left hand for the left ear) with your ring and little fingers resting on the athlete's cheek to stabilize the otoscope.^{2,6} Bracing the otoscope in this manner prevents sudden sharp movements of the speculum in the canal.

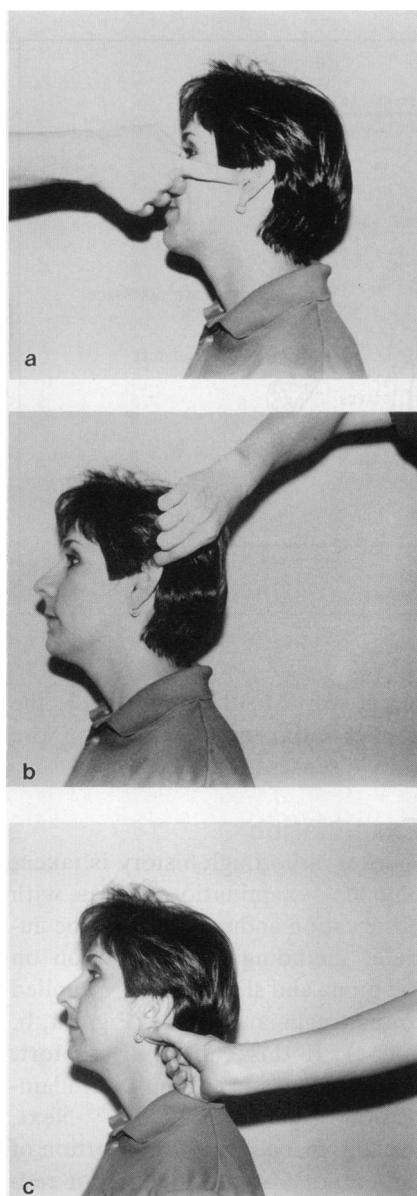


Fig 5.—a, Palpation of tragus; b, traction applied to auricle; c, traction applied to lobule.

While maintaining the gentle traction on the pinna, place the otoscope at, but not in, the ear.⁵ Then insert the speculum into the canal as you "watch your way into the canal."⁸ Avoid blindly inserting the speculum, as this can cause discomfort and possible damage to the canal and/or membrane.^{3,5} The light beam and focus of the otoscope are designed to extend well beyond the tip of the speculum; therefore, it is not necessary to push hard against the outer ear.⁶ The speculum tip acts primarily to keep the instrument centered in the ear canal. If there is difficulty in inserting the speculum or if the athlete experiences

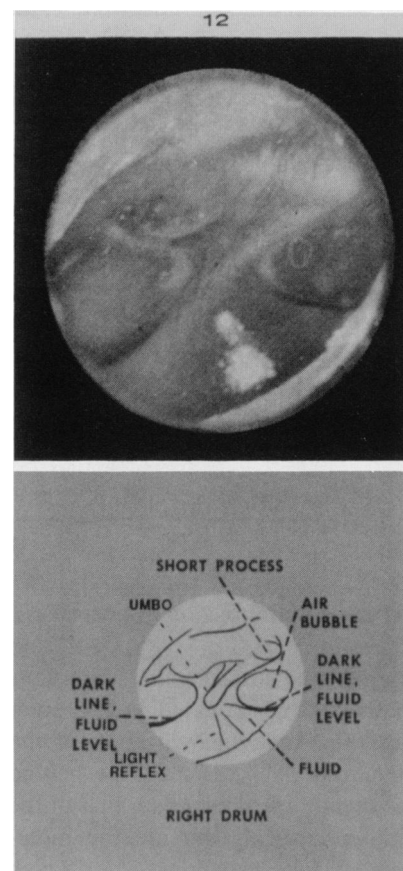


Fig 6.—Presence of fluid and air bubbles behind the tympanic membrane (from Abbott Laboratories; see Fig 3).

pain as you insert the speculum, you should readjust the position of the athlete's head or vary the degree of pull on the pinna. If the pain persists as you introduce the speculum into the canal, even after readjusting the head, halt the examination and refer the athlete to a physician.

Cerumen present in the external canal is a common and normal finding; it may appear red or reddish brown in color under the bright light of the otoscope. Ignore the cerumen unless it obstructs your vision of the tympanic membrane. The ear is designed to move excess cerumen toward the outer portion of the external canal for easy removal. Contrary to common practice, Q-tips or cotton-tipped applicators are not recommended for removing cerumen. They usually drive the cerumen further into the canal.

If the cerumen becomes excessive or hard and impacted, you can loosen the wax with a few drops of dilute hydrogen peroxide.⁵ There are also a

number of commercial preparations available for this purpose. Do not put hydrogen peroxide or commercial preparations into the ear if you suspect a perforated membrane. Doing so can cause permanent hearing loss.

Once the tympanic membrane comes into view, you must tilt or rotate the speculum to view the entire membrane completely. This is similar to trying to view all corners of a room through a keyhole.⁵ Usually, the posterior inferior portion of the membrane will not be visible because of the angle of the drum and the shape of the canal.

When inspecting the tympanic membrane, there are three important landmarks to identify: the malleus, the light reflex, and the annulus.^{3,8} Because of its attachment to the membrane, the malleus is easily identified during an otoscopic examination. The handle of the malleus, or manubrium, is the most prominent structure seen and appears as a nar-

row, opaque band extending inferiorly from the short process of the malleus toward the umbo located at the center of the membrane (Figs 3 and 4). The manubrium will angle toward the 2 o'clock position in the

right ear and the 11 o'clock position in the left ear. The light reflex occurs as a result of the otoscope's light beam reflecting off the semitransparent tympanic membrane and can be seen as a wedge-shaped bright spot

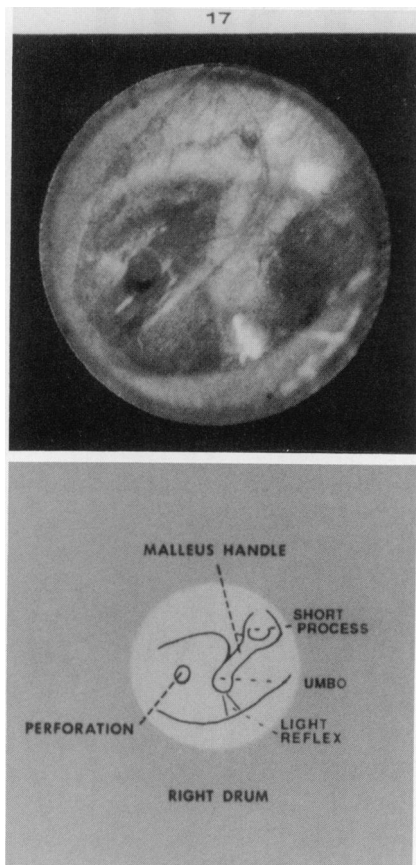


Fig 7.—Perforation of tympanic membrane (from Abbott Laboratories; see Fig 3).

Athlete's Name: _____ Date: _____		
Sport: _____ Position: _____		
History: _____		
Mechanism of Injury/Illness: _____		
	RIGHT EAR	LEFT EAR
External Ear		
normal appearance	_____	_____
tragus tender with palpation	_____	_____
auricle tender with traction	_____	_____
redness	_____	_____
swelling	_____	_____
cuts or bruises present	_____	_____
Ear Canal		
normal appearance	_____	_____
tender with insertion of speculum	_____	_____
bleeding or drainage present	_____	_____
redness	_____	_____
swelling	_____	_____
foreign body present	_____	_____
excessive wax present	_____	_____
Membrane		
normal appearance	_____	_____
unable to view due to wax build-up	_____	_____
retracted	_____	_____
bulging	_____	_____
red	_____	_____
air bubbles present	_____	_____
fluid level present	_____	_____
perforation	_____	_____
Hearing		
normal	_____	_____
decreased	_____	_____
Impression: _____		
Treatment/Recommendations: _____		
Referral to Physician: Y/N Physician's Name: _____		
Physician's Diagnosis: _____		
Physician's Recommendations: _____		
Athletic Trainer's Signature _____ Date _____		

Fig 8.—Ear Examination Record.

originating from the umbo (Fig 6). This light reflex is normally located around the 4 and 8 o'clock positions in the right and left ears, respectively. The third landmark of the membrane, the annulus, forms the outer border of the membrane and serves to attach it to the external canal.

There are several other structures located just behind the membrane that are often visible during an otoscopic evaluation. The junction between the incus and stapes (incudostapedal junction), located at a much deeper level than the malleus, can occasionally be seen through the upper back portion of the membrane (Figs 3 and 4). As shown in Figure 4, the chorda tympani nerve can often be seen passing horizontally across the middle ear just between the long process of the incus and the handle of the malleus.

When examining the membrane, inspect it for clarity, color, and position.⁵ As mentioned previously, the normal tympanic membrane should be shiny, pearl gray, and somewhat translucent. In its normal state, the tympanic membrane appears slightly avascular; however, after physical activity, prolonged examination of the ear, or in inflammatory conditions, the vessels of the membrane may become quite prominent.² The position of the membrane should not bulge or retract inward. With practice, you should learn to look beyond or through the membrane to inspect for the presence of fluid or air bubbles in the middle ear space (Fig 6). Always inspect the membrane for marginal or midsubstance perforations or tears. Perforations will usually appear as round or oval holes through which a pocket or dark shadow can be seen (Fig 7).^{3,8}

You should functionally test the ear after completing your otoscopic examination. Perform a simple hearing test using your voice as a stimulus. Begin by whispering numbers or short phrases at a distance of 1 to 2 feet, followed by a louder spoken voice if the athlete is unable to hear. During this test, ask the athlete to cover the opposite ear completely with his/her hand and be sure he/she cannot see you talk.³ Figure 8 illustrates an ear examination record that

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James, Alan	10075	08/15/93	Football	SportsMedicine V-League
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Table 1.—Summary of Otoscopic Findings

Finding	Possible Interpretation	Possible Pathology
Red, tender canal	Inflammation	Otitis externa
Bright red membrane	Inflammation	Otitis media
Yellowish membrane	Pus or fluid in middle ear space	Otitis media
Bluish membrane	Blood in middle ear space	Skull fracture
Bubbles behind membrane	Fluid in middle ear space	Chronic otitis media
Absent light reflex	Bulging of membrane	Otitis media
Oval dark areas	Perforation	Rupture of membrane
Malleus very prominent	Retraction of membrane	Obstruction of eustachian tube

can be used for documenting evaluation findings.

Postexamination

Following each otoscopic examination, thoroughly disinfect the speculum tips. First scrub them with hot water to remove all wax particles and then soak them in a covered dish of rubbing alcohol for 10 min.⁶ Disposable speculum tips are also available and may be more convenient than disinfecting the tips after each use.

Common Pathologic Conditions of the Ear

Illnesses

Otitis externa, or “swimmer’s ear,” is an infection of the external auditory canal and is a common infection seen in athletes.¹ It usually results from prolonged exposure to the water, which creates a moist environment for bacterial or fungal growth.⁷ Otitis externa causes the canal to become red, swollen, and tender. The canal may also become edematous and filled with a foul-smelling thick gray or white exudate.⁷ The athlete will experience pain when the pinna is tugged or the tragus is palpated. Once you suspect this condition, refer the athlete to a physician for antibiotic treatment. This condition may be prevented by regularly using a commercial drying agent such as Swim Ear or a mixture of alcohol and water following prolonged exposure to water. Swimmers can also use a hair dryer to dry the ear canal after exposure to water.

Otitis media, an infection of the middle ear, often follows or accompanies

an upper respiratory infection. Symptoms include pain without tenderness to touch, a fullness or roaring in the ear, a feeling of pressure, fever, hearing loss with the sensation of “being in a barrel,” and, sometimes, balance disturbance. The pain or pressure will usually subside almost instantly if the tympanic membrane ruptures.⁷ Otoscopic examination of otitis media reveals a red and often bulging tympanic membrane. As the membrane bulges, the light reflex becomes distorted or absent altogether. If the Eustachian tube becomes obstructed, the middle ear space will become blocked. In an attempt to equalize pressure, the middle ear space will begin absorbing air through the paper-thin membrane. This creates a vacuum, which, in turn, causes the tympanic membrane to retract. During an otoscopic examination, this retracted membrane will be quite obvious as will a yellowish fluid level or a collection of air bubbles behind the membrane.⁴ Table 1 summarizes the common abnormalities that might be found during an otoscopic examination.

Refer all athletes suspected of having an ear infection to a physician for proper treatment. Untreated infections can result in permanent damage to the ear.

Trauma-related Conditions

The basic construction of the auricle provides little or no room for the accumulation of fluid or blood between the skin and underlying cartilage. Deformity of the ear can result from an injury to the external ear which produces swelling of the auricle. An auricular hematoma, also known as “cauliflower ear,” may result from a contusion, repetitive friction, or twisting of the auri-

cle.¹ This condition, once common among wrestlers and boxers, is not as prevalent today, due to the improvement of protective head gear. When treating an auricular hematoma, apply ice and compression to prevent or reduce swelling in the auricle. If swelling or hemorrhaging continue, refer the athlete to a physician.¹

The tympanic membrane can be perforated by the introduction of a foreign object into the ear, a sharp blow to the head, a sudden pressure change, or exposure to an extremely loud noise. A perforated membrane is not a medical emergency and usually will heal spontaneously^{1,2} within 3 months.² However, you should refer all athletes with a suspected membrane perforation to a physician for proper care. Water entering the middle ear space through a perforated membrane can result in permanent hearing loss. For this reason, advise the athlete to prevent water from entering the ear. You can place cotton in the ear to absorb drainage; however, be careful not to push the cotton very far into the external auditory canal. As a general rule, consult your team physician if you are unable to see the tympanic membrane during otoscopic evaluation due to swelling, wax, or drainage.

You should evaluate the ear for possible injury following any type of head injury. If you notice blood in the external auditory canal, you should always consider the possibility of a skull fracture. Bleeding in the canal, however, usually results from canal lacerations. If you see blood behind the membrane during your otoscopic examination, refer the athlete to a physician. Additionally, if you notice cerebrospinal fluid draining from the canal following a

head injury, you should immediately refer the athlete to a physician.¹

Conclusion

As mentioned earlier, this article is not intended to teach proficiency in the use of the otoscope. Like any evaluation technique, otoscopic evaluation requires extended practice to develop and maintain proficiency. The details discussed in this article regarding the subtle findings of otoscopic examination are intended to be of use to you as you continue refining your skills with the otoscope. I recommend that you contact your team physician and/or local ear, nose, and throat specialist to obtain professional guidance and instruction

in the proper technique of otoscopic examination. Remember, you must gain experience looking at many normal ears in order to accurately recognize abnormal findings.

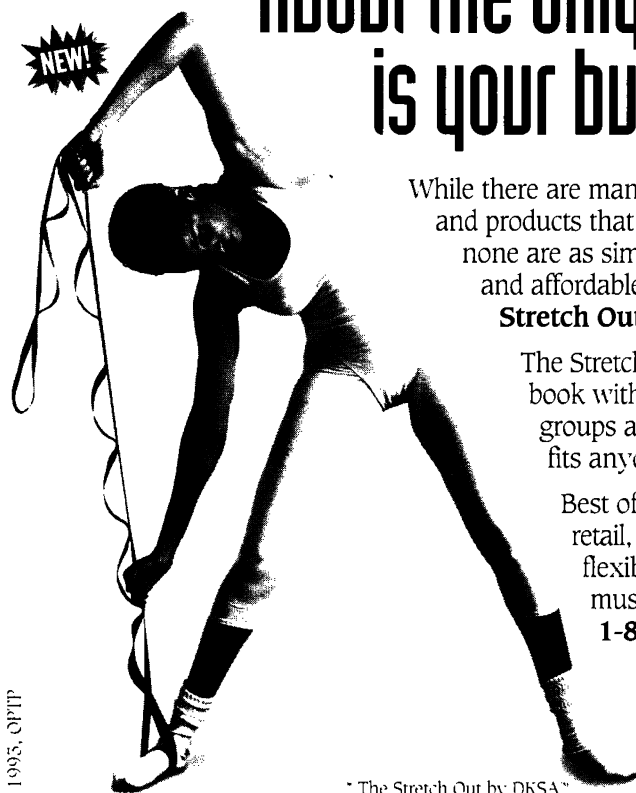
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References

1. Booher JM, Thibodeau GA. *Athletic Injury Assessment*. St. Louis, MO: Times Mirror/Mosby College Publishing; 1989:287-290.
2. Hawke M, Keene M, Alberti PW. *Clinical Otoscopy*. New York, NY: Churchill Livingstone; 1984:15-18,24-25,28,32.
3. Hillman RS, Goodell BW, Grundy SM, McArthur JR, Moller JH. *Clinical Skills: Interviewing, History Taking, and Physical Diagnosis*. New York, NY: McGraw-Hill, Inc; 1981:209-211.
4. Jones SS, Harter RA. Proficiency and use of the ophthalmoscope and otoscope in recognition and evaluation of eye and ear injuries and illnesses in sport. Abstract presented at the 41st Annual Meeting and Clinical Symposium of the National Athletic Trainers' Association; June, 1990; Indianapolis, Ind.
5. Marty DR. *The Ear Book*. Jefferson City, MO: Lang ENT Publishing; 1987:3-8, 17-25, 43-44, 49-59, 80.
6. *Notoco Earscope Instruction Booklet*. Ferndale, CA: Notoco; 1983:1-2.
7. Seidel HM, Ball JW, Dains JE, Benedict GW. *Mosby's Guide to Physical Examination*. St. Louis, MO: CV Mosby Company; 1987:203:237-238.
8. Sherman JL Jr, Fields SK. *Guide to Patient Evaluation*. 4th Ed. Garden City, NY: Medical Examination Publishing Co, Inc; 1982:127-131.

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